AD-A065 170 SAN DIEGO AIRCRAFT ENGINEERING INC CALIF F/G 1/5
TASK REPORT ON A ONE-HALF SCALE LABORATORY MODEL OF A RIGID-HOL--ETC(U)
MAY 78 P SORENSEN N62269-78-Q-5137
UNCLASSIFIED SAE-78-016 NADC-79026-20 NL

1 OF 1
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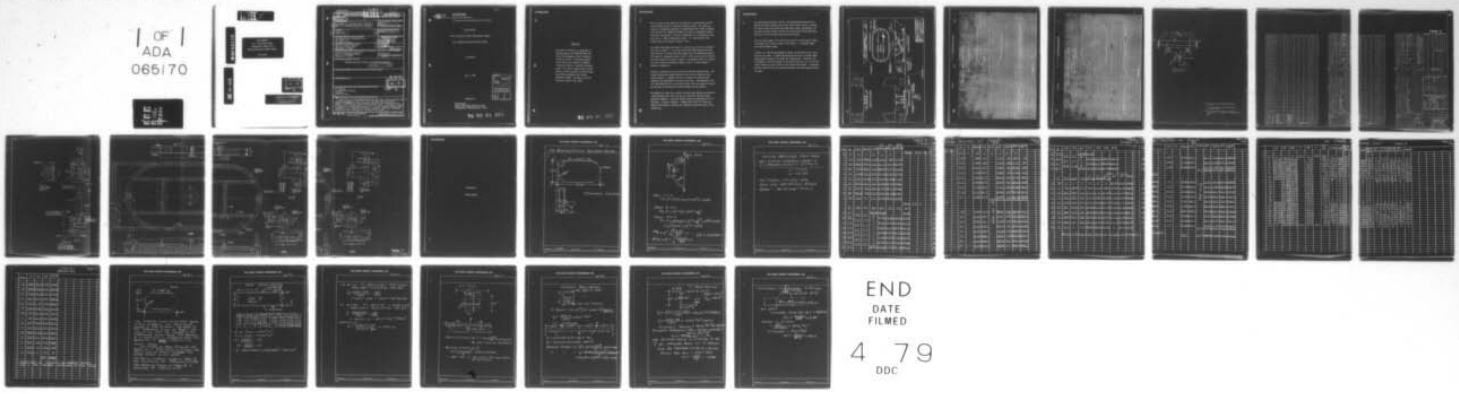

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

LEVEL II

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER

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7. AUTHOR(s): P. Sorensen

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San Diego, CA 92110

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Warminster, PA 18974

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SAE-78-016

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Air Bearing
Aircraft/Ship Interface
Hold-Down
V/STOL Aircraft

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A description of the recommended baseline rigid skirt hold-down system ~~is~~ was presented in Sandaire report SAE 77-005, developed under Contract No. N62269-77-C-0046. This report documents the design and construction of a one-half scale laboratory model of the baseline system. This model is needed to demonstrate the hold-down concept and to evaluate system performance and development risk. Model design criteria, operating conditions, dimensioned drawings and stress analyses are included in this report.

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S/N 0102-LF-014-6601

UNCLASSIFIED 388 450 RLH

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SANDAIRE

San Diego Aircraft Engineering, Inc.

3777 Gaines Street, San Diego, California 92110 · (714) 291-2512

TASK REPORT

ON A ONE-HALF SCALE LABORATORY MODEL

OF A RIGID HOLD-DOWN SKIRT SYSTEM

SAE 78-016

May 1, 1978

Submitted to

COMMANDER
NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PENNSYLVANIA 18974

PREFACE

This report is submitted as a requirement of Purchase Request No. 62269/SR7-5050 with Naval Air Development Center, Warminster, Pennsylvania 18973. The Purchase Request was for services and materials to fabricate a laboratory model of a rigid skirt hold-down system. The model is approximately one-half scale of a system presented in Sandaire Report SAE 77-005, developed under Contract N62269-77-C-0046. This report covers the construction details of the model.

This is a report on the design and construction of an approximately one-half scale laboratory model of a rigid skirt hold-down system. The model was based on a configuration presented in Sandaire Report SAE 77-005, developed under Contract No. N62269-77-C-0046, for Naval Air Development Center, Warminster, Pennsylvania. This basic configuration has a 10,000-pound hold-down force at 1.824 psi differential pressure. It is reproduced from the original report and presented as Figures 1 and 2.

The initial model design was based on a one-half area scale of the configuration shown in Figure 1. It was later agreed with NADC personnel that the model would be a one-half scale force model using 3 psi differential pressure. This results in a dimensional scale of .551 to 1 and an area scale of .304 to 1. The basic dimensions are shown in Figure 3, and drawings used in the construction of the model are presented in Figures 4 and 5. A stress analysis is enclosed as Appendix A.

The skirt is constructed of a pine wood core faced with aluminum sides. This method minimized the tooling required to assure the skirt shape and cross-section required. In addition, the use of a wooden core facilitates the installation and replacement of the deck contact seal. The dimensions of the skirt were dictated by the cross-sectional moment of inertia required to prevent the flat sides from deflecting and causing binding with the platform.

The platform was made from a section of aircraft cargo flooring and consists of a solid end-grain balsa wood core with two .040 sheet aluminum facings attached by adhesives. The basic flooring material was fabricated by M. C. Gill Corp., El Monte, California. Standard AND 10139 "Z" section was bolted to the platform to distribute the 5,000-pound hold-down force to four reaction lugs.

Two spring-loaded pneumatic actuators are attached between the skirt and platform to provide snubbing action and to raise or lower the skirt. Knowing the actuator piston area (2.405 and 2.209 square inches, respectively), and the system actuation pressure, the skirt seal contact force can be determined. This may be of some benefit during final system testing.

The total model weight is 71.5 pounds and consists of a skirt-actuator weight of 36 pounds and a platform weight of 35.5 pounds. A comparable flight unit would be lighter weight.

A Rotron, Inc. DR8 (10 hp) regenerative blower was purchased as the vacuum source for the model. It weighs 250 pounds and must have a suitable support during operation because of its weight and starting torque. Therefore, it is not feasible to connect the blower to the model at this time, but a small shop vacuum cleaner was used to check out the sealing characteristics. It appeared from this limited test that the model should perform quite well during the final test phase.

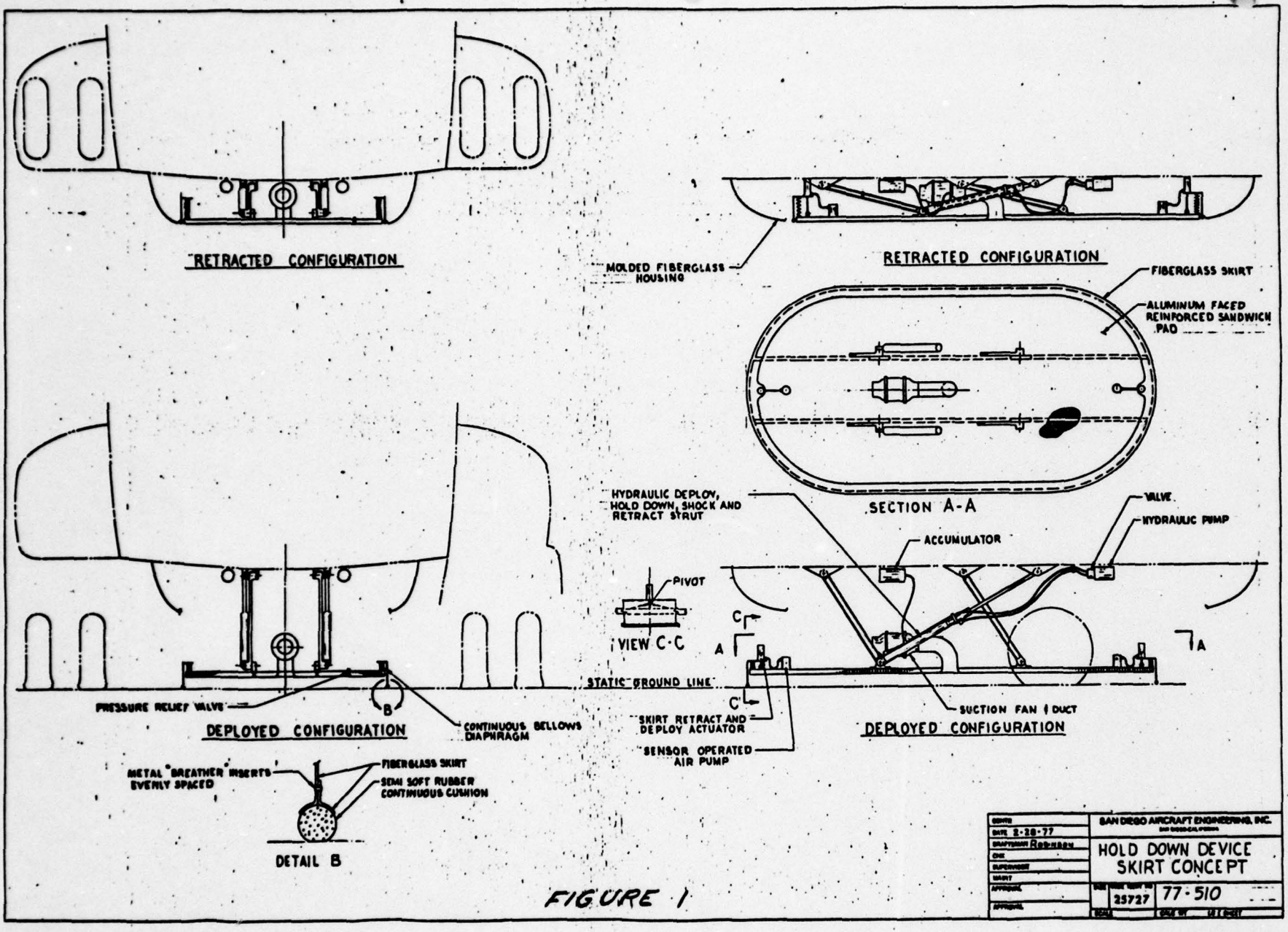

RETRACTED CONFIGURATION
MOLDED FIBERGLASS HOUSING
RETRACTED CONFIGURATION
FIBERGLASS SKIRT
ALUMINUM FACED REINFORCED SANDWICH PAD
SECTION A-A
HYDRAULIC DEPLOY, HOLD DOWN, SHOCK AND RETRACT STRUT
VALVE
HYDRAULIC PUMP
ACCUMULATOR
PIVOT
VIEW C-C
C
A
A
STATIC GROUND LINE
C
PRESSURE RELIEF VALVE
B
CONTINUOUS BELLOWS DIAPHRAGM
SUCTION FAN & DUCT
SKIRT RETRACT AND DEPLOY ACTUATOR
SENSOR OPERATED AIR PUMP
DEPLOYED CONFIGURATION
DEPLOYED CONFIGURATION
METAL BREATHER INSERTS EVENLY SPACED
FIBERGLASS SKIRT
SEMI SOFT RUBBER CONTINUOUS CUSHION
DETAIL B
DATE 8-28-77
SAN DIEGO AIRCRAFT ENGINEERING, INC.
HOLD DOWN DEVICE SKIRT CONCEPT
23727
77-510

FIGURE 1

BASE POINT RIGID SKIRT SYSTEM

F_S = 10000 LBS

AREA CUSHION = 38.07 FT^2

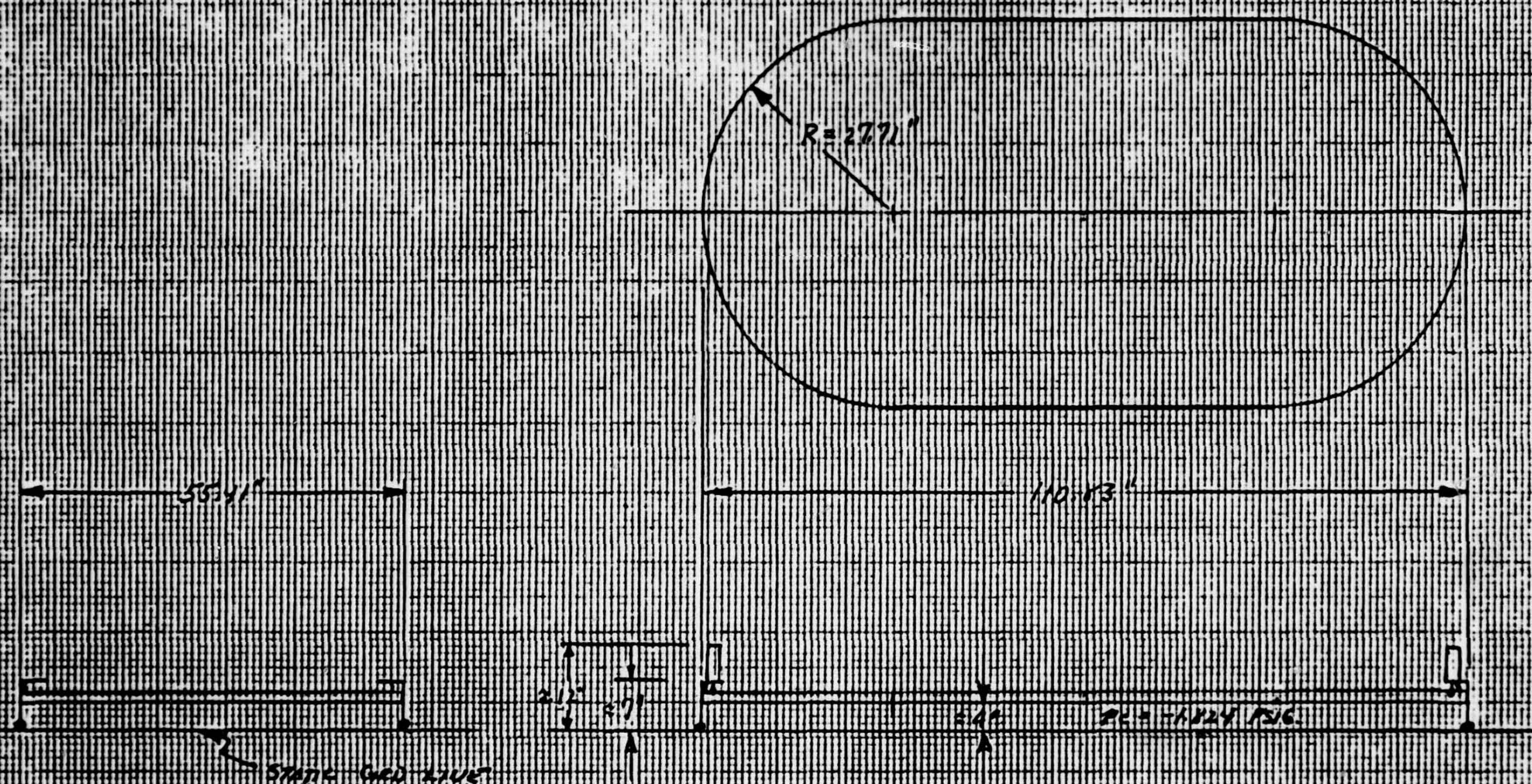


FIGURE 2

K+E 10 X 10 TO THE CENTIMETER 18 X 25 CM.
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1513

BASIC MODEL RIGID SKIRT SYSTEM

F_S = 5000 LBS
AREA CUSHION = 1666.6 IN^2
11.57 FT^2

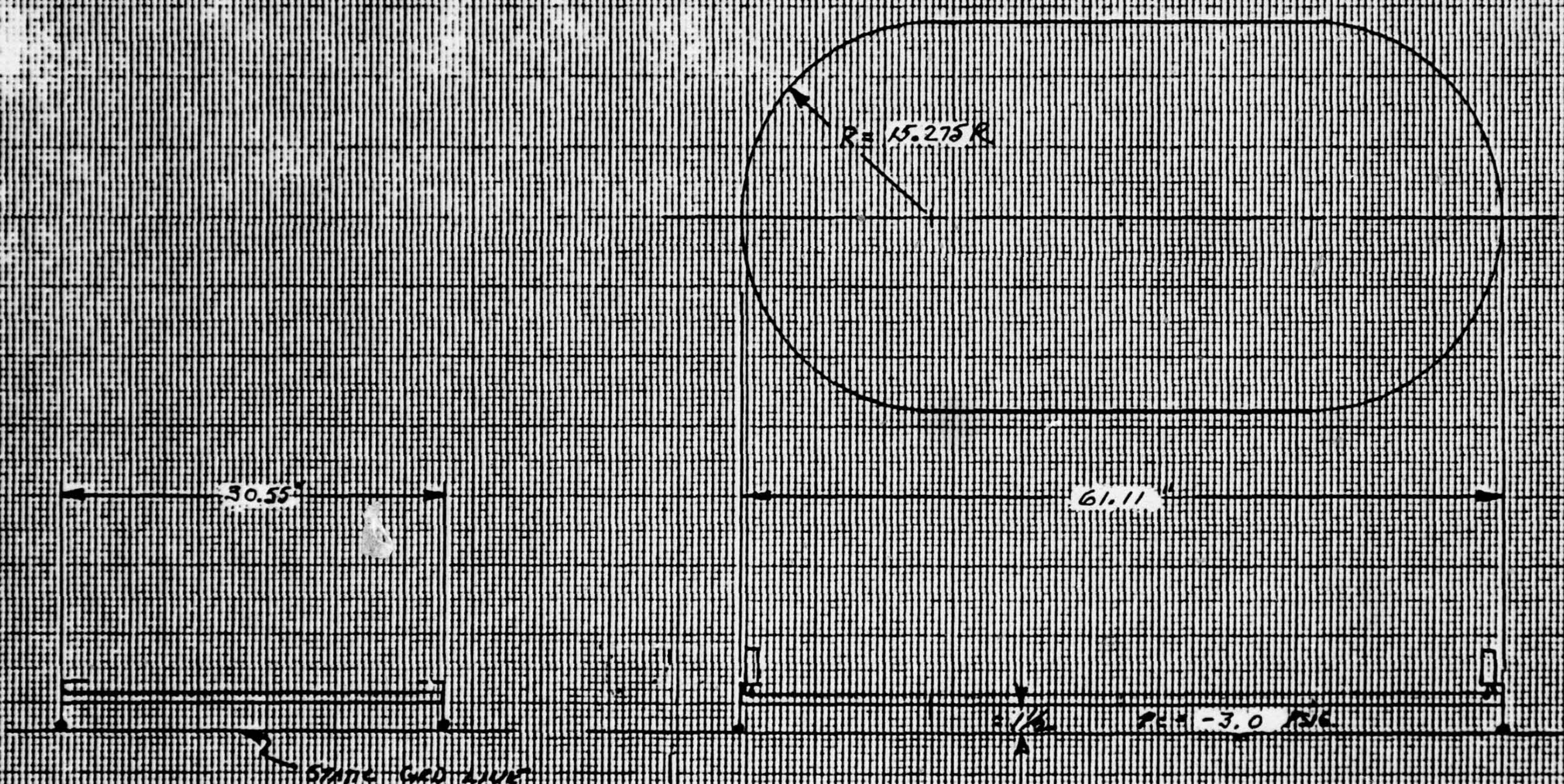
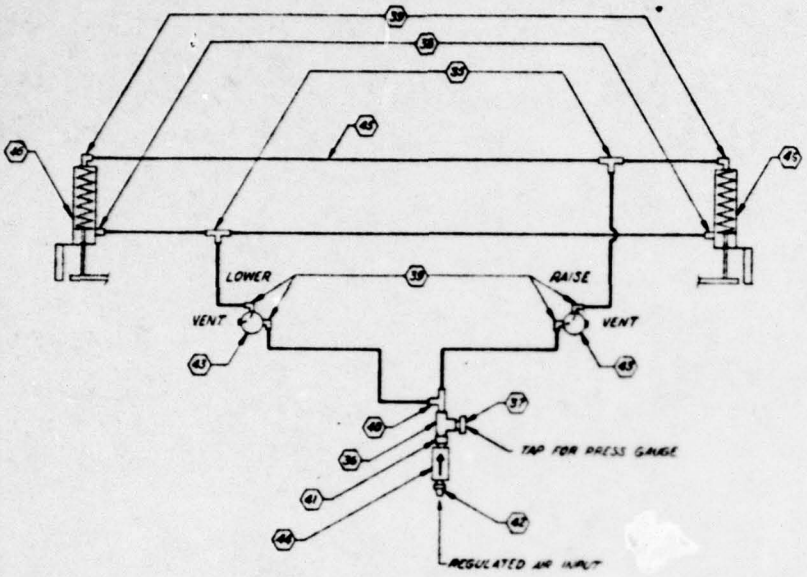


FIGURE 3



SCHEMATIC - PNEU POS SYS

(XX) = SYMBOL NO. IN L/M

3. MAY BE MADE FROM ¼ THICK LAMINATIONS OR BY CERFING COMP FLG

2. DO NOT SCALE DWG. MAIN VIEW OUT OF SCALE RESULTING FROM MODEL SIZE CHANGE

1. FAB USING 100 PARTS BY WT OF EPIBOND 122 AND 12 PARTS BY WT OF 952 HARDENER. POT LIFE APPROX 45 MIN. CURE ABOVE 90°F FOR 12 HRS

NOTES:

-37	-5	-3	-1	SYMBOL	NOMENCLATURE OR DESCRIPTION	CODE IDENT	PART OR IDENTIFYING NO	MATERIAL SPECIFICATION	MATERIAL [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	2	56		51	WASHER		AN960-416						
		4		50	NUT		MS21083N06						
		4		49	WASHER		MS35338-41						
		4		48	SCREW		MS35206-328						
		2		47	NUTPLATE		NAS1031A8						
	2			46	AIR CYLINDER		242-R		BIMBA MFG CO MONEE, ILL 60449				

QUANTITY REQD PER DASH NO

LIST OF MATERIALS OR PARTS LIST

Note	-37	-5	-3	-1	SYMBOL	NOMENCLATURE OR DESCRIPTION	CODE IDENT
				AR	45	POLY FLO TUBING	
				1	44	VALVE, DISC CHECK	
				2	43	VALVE, 3 WAY	
				1	42	REDUCING NIPPLE	
				1	41	ADAPTER	
				1	40	MALE RUN TEE	
				6	39	MALE ELBOW	
				2	38	MALE CONNECTOR	
				1	37	PLUG	
				1	36	TEE	
				2	35	UNION TEE	
			4		34	BOLT	
			4		33	BOLT	
			44		32	BOLT	
		2	56		31	NUT	
		106			30	SCREW WOOD	
		4	52		29	WOOD	
		2	4		28	SCREW	
		56	16		27	RIVET	
1	AR				26	HARDENER	
1	AR				25	ADHESIVE	
		2			24	SEAL	
		2			23	ANGLE	
		2			22	RETAINER	
		2			21	COVER	
		2			20	BRACKET	
1		1			19	SKIRT	
	2				18	CORE	
3	4				17	CAP	
	4				16	DOUBLER	
	2				15	INNER SKIN	
	2				14	OUTER SKIN	
			2		13	FILLER	
			2		12	SEAL	
			1		11	SEAL	
			1		10	BELLMOUTH	
			2		9	RETAINER	
			4		8	ANGLE	
			4		7	FITTING	
			2		6	BRACE	
			2		5	STIFFENER	
			1		4	PLATFORM	
				1	3	SKIRT ASSY	
				1	2	PLATFORM ASSY	
					1	MODEL	

QUANTITY REQD PER DASH NO

CONT TIN CODE	NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
	APPLICATION		QTY REQD	

2

FIGURE 4

-37	-5	-3	-1	SYMBOL	NOMENCLATURE OR DESCRIPTION	CODE IDENT	PART OR IDENTIFYING NO.	MATERIAL SPECIFICATION	MATERIAL OR NOTES	SIZE OR SHAPE	UNIT WT		HEAT TREAT CONDITION
			AR	45	POLY FLO TUBING		66 P	} OD-NATURAL COLOR		GOULD INC, VALVE & FTG DIV CHICAGO, ILL 60648			
			1	44	VALVE, DISC CHECK		81-C-02						
			2	43	VALVE, 3 WAY		343 B-4A						
			1	42	REDUCING NIPPLE		123-B-04X02						
			1	41	ADAPTER		120-B-04X02						
			1	40	MALE RUN TEE		271-P-06X04						
			6	39	MALE ELBOW		269-P-06X04						
			2	38	MALE CONNECTOR		268-P-06X04						
			1	37	PLUG		121-B-04						
			1	36	TEE		127-B-04						
			2	35	UNION TEE		264-P-06X04			GOULD INC, VALVE & FTG DIV CHICAGO, ILL 60648			
		4		34	BOLT		AN4-7A						
		4		33	BOLT		AN4-6A						
		44		32	BOLT		AN4-16A						
	2	56		31	NUT		MS51922-5						
	106			30	SCREW WOOD		MS35492-30						
	4	52		29	WOOD		MS35492-54						
	2	4		28	SCREW		MS24694-S117						
	56	16		27	RIVET		MS20426AD4-7						
▷1 AR				26	HARDENER		952	}	FURANE PLASTICS INC 5121 SAN FERNANDO RD WEST LOS ANGELES, CA				
▷1 AR				25	ADHESIVE		EPIBOND 122						
	2			24	SEAL		-47	MAKE FROM COMMERCIAL NEOPRENE DIE NO. 1606 RUBBERCRAFT CORP. TORRANCE, CA 90502					SHORE 50-60
	2			23	ANGLE		-45	QQ-A-200/11	7075 AL	MAKE FROM AND10139-1303			-T6
	2			22	RETAINER		-43	QQ-A-327	6061 AL	.064 SHT			-T6
	2			21	COVER		-41	|	|	.064 SHT			|
	2			20	BRACKET		-39	QQ-A-327	6061 AL	.125 SHT			-T6
▷1	1			19	SKIRT		-37						
2				18	CORE		-35	SELECT CLEAR PINE		1X4			
▷3 4				17	CAP		-33	SELECT CLEAR PINE		1X1			
4				16	DOUBLER		-31	QQ-A-327	6061 AL	.125 SHT			-T6
2				15	INNER SKIN		-29	|	|	|			|
2				14	OUTER SKIN		-27	|	|	|			|
		2		13	FILLER		-25	QQ-A-327	6061 AL	.125 SHT			-T6
		2		12	SEAL		-23	MAKE FROM COMMERCIAL NEOPRENE DIE NO. 1541 RUBBERCRAFT CORP. TORRANCE, CA 90507					SHORE 50-60
		1		11	SEAL		-21		MAKE FROM 732 RTV SEALANT DOW CORNING CORP. MIDLAND, MICH 48640				
		1		10	BELLMOUTH		-19		MAKE FROM FIBERGLASS & EPOXY				
		2		9	RETAINER		-17	QQ-A-327	6061 AL	.064 SHT			-T6
		4		8	ANGLE		-15	QQ-A-200/11	7075 AL	MAKE FROM AND10139-1303			-T6
		4		7	FITTING		-13	QQ-A-250/13	7075 CLAD AL	.250 PLATE			-T651
		2		6	BRACE		-11	QQ-A-200/11	7075 AL	AND10139-1303			-T6
		2		5	STIFFENER		-9	QQ-A-200/11	7075 AL	AND10139-1303			-T6
		1		4	PLATFORM		-7	MAKE FROM GILLFAB 5040 + .100 THICK WITH .040 - 6061-T6 AL FACES M.C. GILL CORP, EL MONTE, CA 91731					
			1	3	SKIRT ASSY		-5						
			1	2	PLATFORM ASSY		-3						
				1	MODEL		77-523-1						

QUANTITY REQD PER DASH NO.

LIST OF MATERIAL OR PARTS LIST

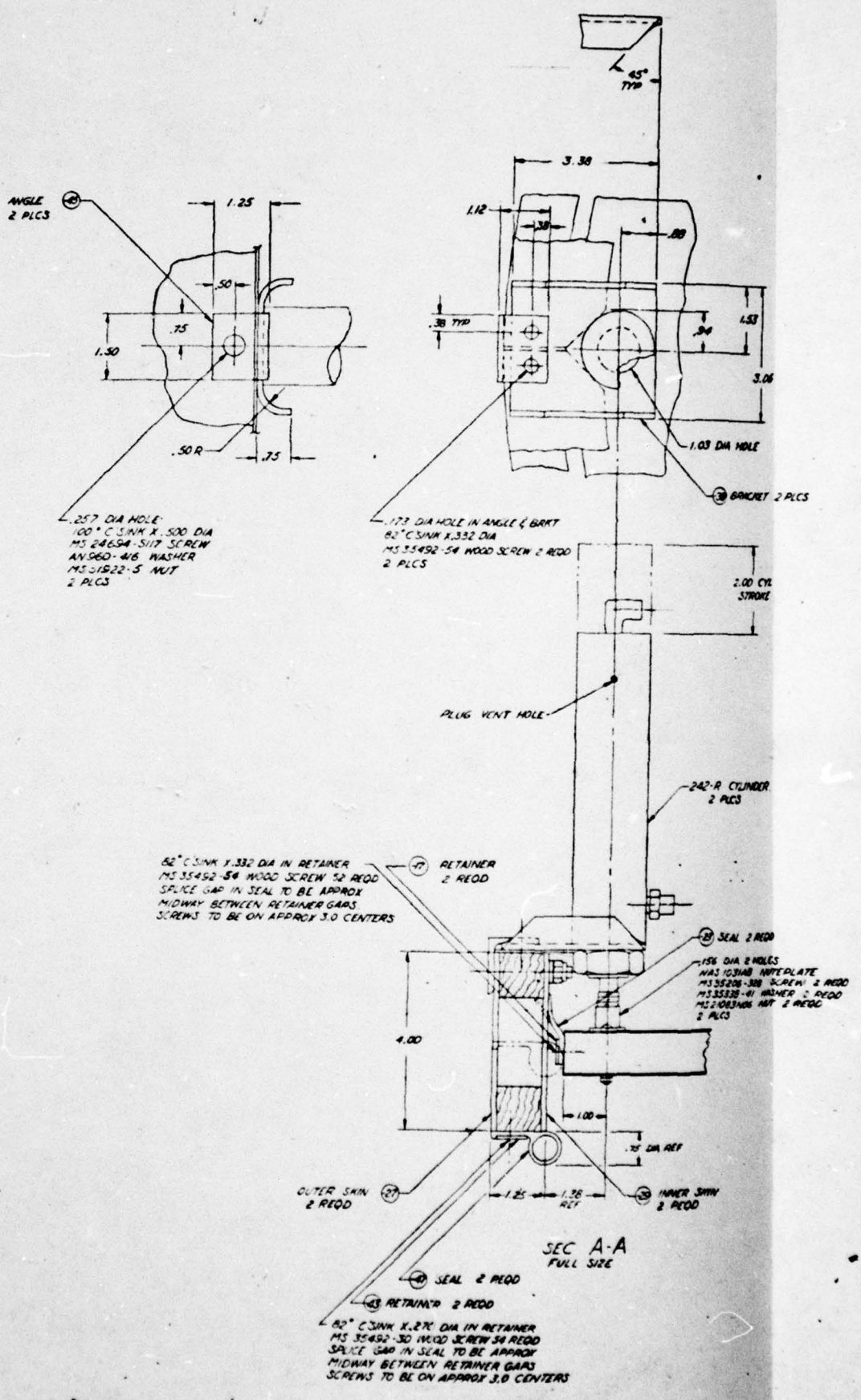
Company	SAN DIEGO AIRCRAFT ENGINEERING, INC
Title	LABORATORY MODEL - RIGID SKIRT HOLD DOWN SYSTEM
Draftsman	E. NAEL
Code Ident No.	25727
Drawing No.	77-523
Scale	NOTED
Sheet	1 of 2

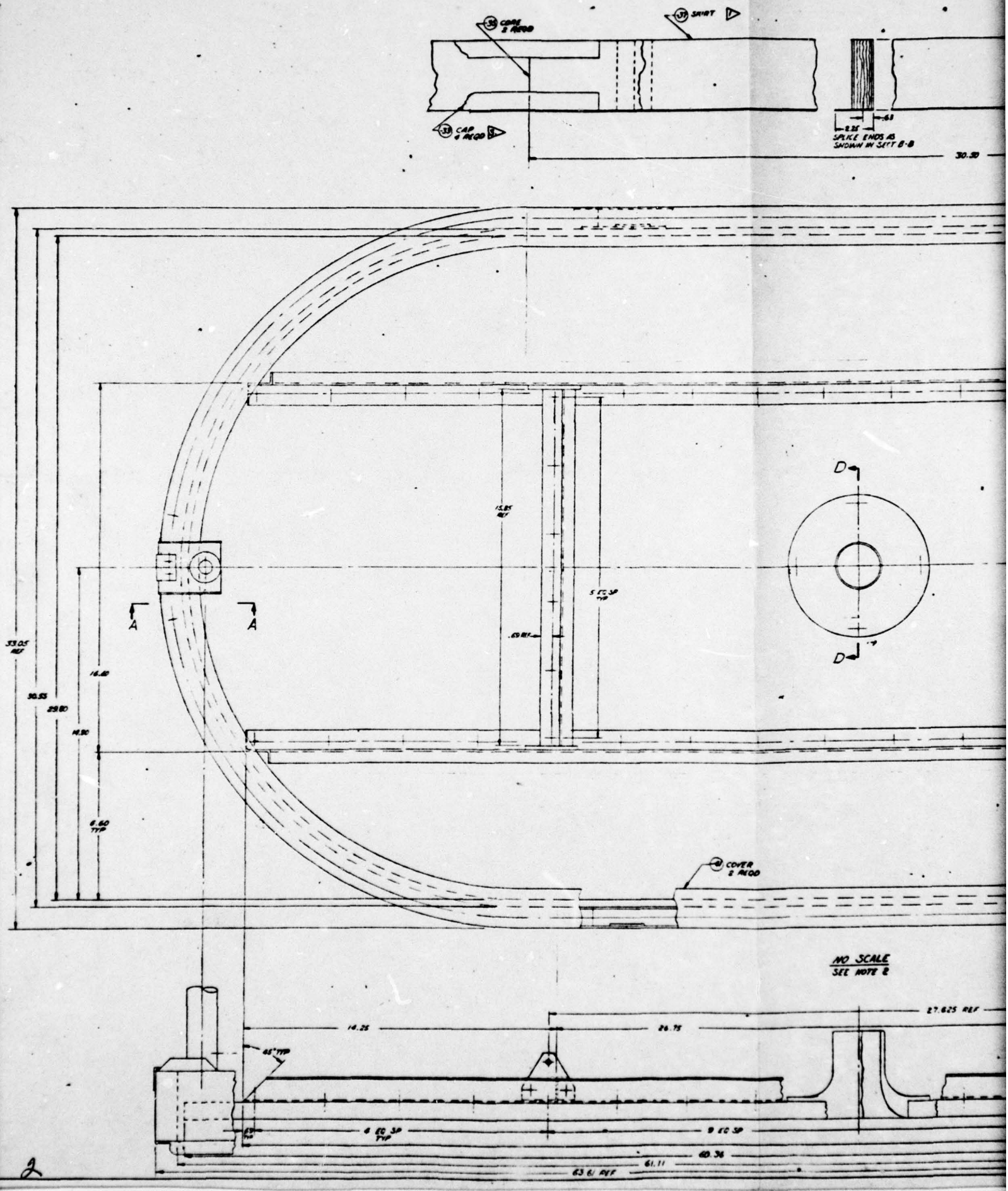
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES; TOLERANCES ON: FRACTION, DECIMAL, ANGLE

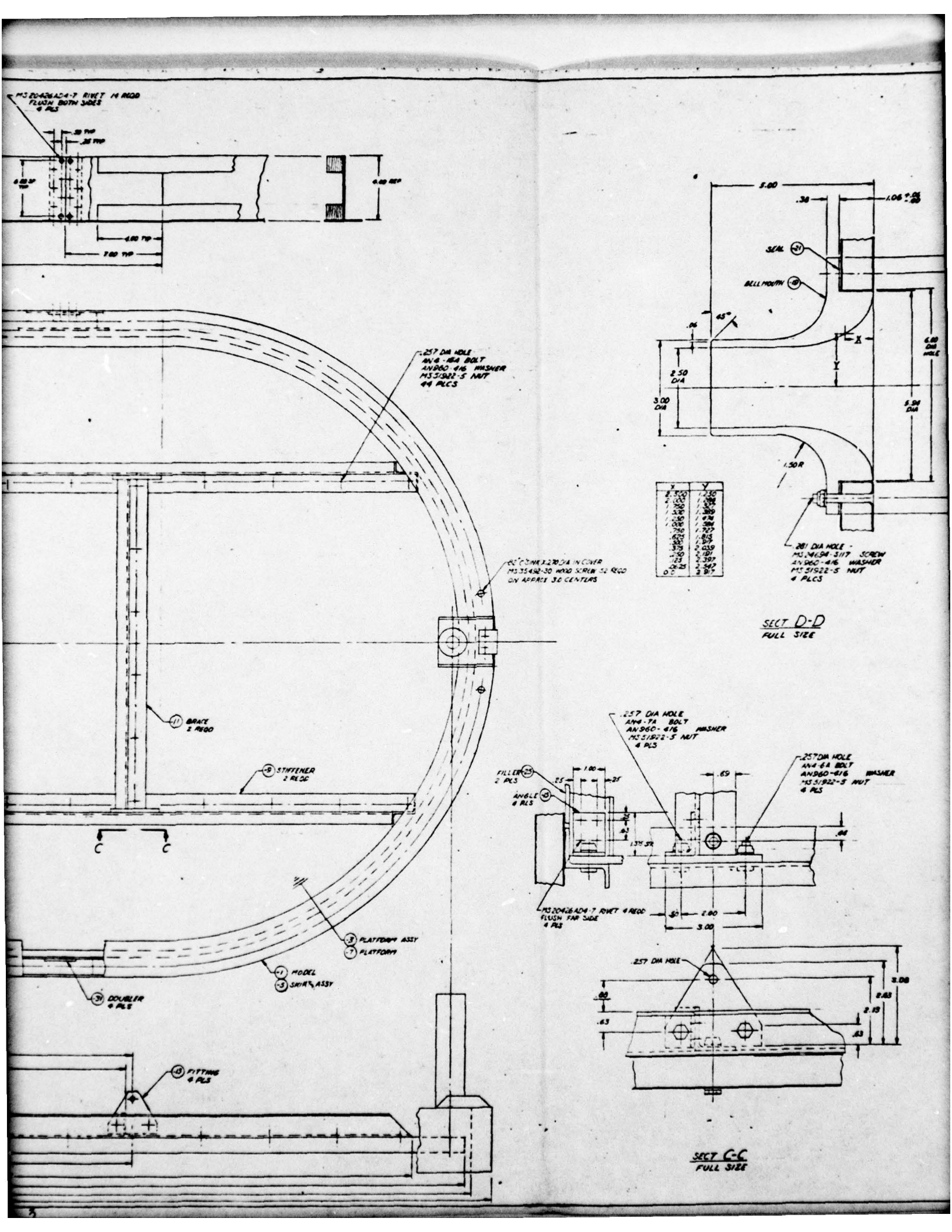
ODD DASH NUMBER SHOWN; NEXT HIGHER CONSECUTIVE EVEN DASH NUMBER OPP

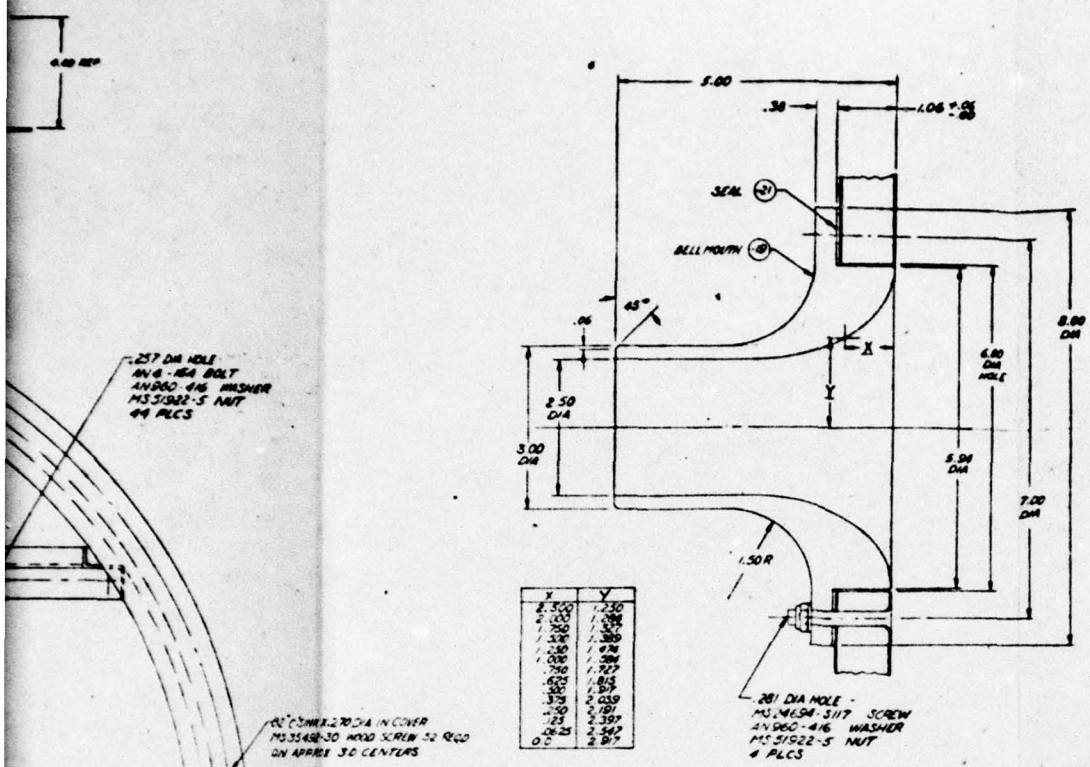
NEXT ASSY — USED ON — NEXT ASSY — FINAL ASSY — APPLICATION — QTY REQD

BIMBA MFG CO MONEE, ILL 60449


45° TYP
3.38
1.12
.38
.88
.38 TYP
.94
4.53
3.06
1.03 DIA HOLE
(38) BRACKET 2 PLCS
ANGLE (28) 2 PLCS
1.25
.50
.75
1.50
.50 R
.75
.257 DIA HOLE:
100° C'SINK X .500 DIA
MS 24694-S117 SCREW
AN960-416 WASHER
MS51822-5 NUT
2 PLCS
.173 DIA HOLE IN ANGLE & BRKT
82° C'SINK X.332 DIA
MS35492-54 WOOD SCREW 2 REQD
2 PLCS
2.00 CYL STROKE
PLUG VENT HOLE
242-A CYLINDER 2 PLCS
82° C'SINK X.332 DIA IN RETAINER
MS35492-54 WOOD SCREW 52 REQD
SPLICE GAP IN SEAL TO BE APPROX
MIDWAY BETWEEN RETAINER GABS
SCREWS TO BE ON APPROX 3.0 CENTERS
(41) RETAINER 2 REQD
(39) SEAL 2 REQD
.156 DIA 2 HOLES
MAS 1003A8 NUTPLATE
MS35206-288 SCREW 2 REQD
MS35338-41 WASHER 2 REQD
MS21083N06 NUT 2 REQD
2 PLCS
4.00
1.00
.75 DIA REF
OUTER SKIN (27) 2 REQD
1.25
1.38 REF
(30) INNER SKIN 2 REQD
SEC A-A
FULL SIZE
(40) SEAL 2 REQD
(43) RETAINER 2 REQD
82° C'SINK X.270 DIA IN RETAINER
MS 35492-30 WOOD SCREW 34 REQD
SPLICE GAP IN SEAL TO BE APPROX
MIDWAY BETWEEN RETAINER GABS
SCREWS TO BE ON APPROX 3.0 CENTERS

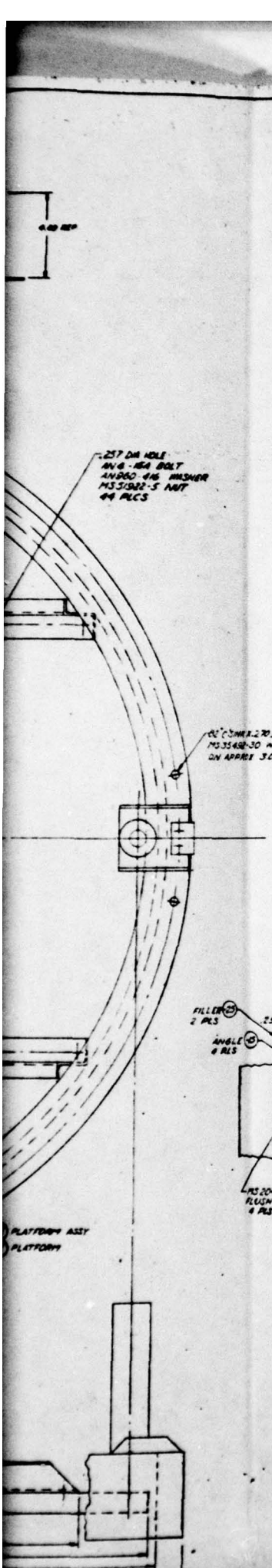

(36) CORE 2 REQD
(37) SHOT
(38) CAP 4 REQD
SPLICE ENDS AS SHOWN IN SECT B-B
30.30
A
A
D
D
15.85 REF
5 EQ SP TYP
.69 REF
33.05 REF
30.55
29.80
16.40
14.90
6.60 TYP
(4) COVER 2 REQD
NO SCALE
SEE NOTE 2
14.25
26.75
27.625 REF
45° TYP
4 EQ SP TYP
9 EQ SP
40.36
63.61 REF
61.11

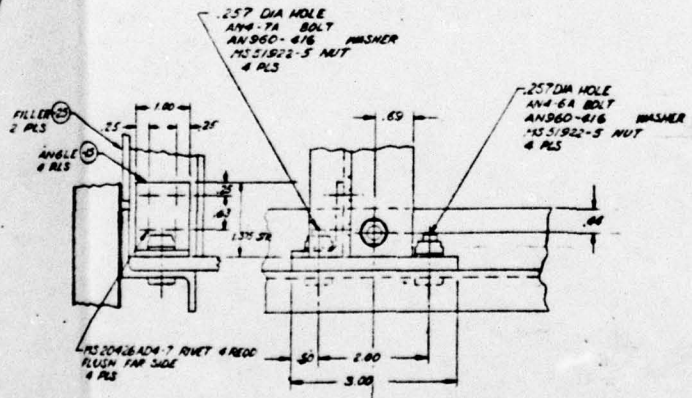

MS 20426AD4-7 RIVET 14 REQD FLUSH BOTH SIDES 4 PLS
.257 DIA HOLE AN4-18A BOLT AN960 416 WASHER MS 51922-5 NUT 44 PLCS
82° C'SINK X .270 DIA IN COVER MS 35490-30 WOOD SCREW 32 REQD ON APPROX 30 CENTERS
(11) BRACE 2 REQD
(9) STIFFENER 2 REQD
C
C
(5) PLATFORM ASSY
(7) PLATFORM
(1) MODEL
(3) SKIN ASSY
(31) DOUBLER 4 PLS
(13) FITTING 4 PLS
5.00
.38
1.06 +.05 -.03
SEAL (21)
BELL MOUTH (18)
45°
.16
X
Y
2.50 DIA
3.00 DIA
6.00 DIA HOLE
5.94 DIA
1.50R
.281 DIA HOLE - MS 24694-S117 SCREW AN960-416 WASHER MS 51922-5 NUT 4 PLS
SECT D-D
FULL SIZE
.257 DIA HOLE AN4-7A BOLT AN960-416 WASHER MS 51922-5 NUT 4 PLS
FILLER (25) 2 PLS
ANGLE (13) 4 PLS
1.00
.25
.25
.69
.257 DIA HOLE AN4-6A BOLT AN960-616 WASHER MS 51922-5 NUT 4 PLS
.63
.63
1.375 SR
.44
MS 20426AD4-7 RIVET 4 REQD FLUSH FAR SIDE 4 PLS
.50
2.00
3.00
.257 DIA HOLE
.69
.63
3.00
2.63
2.13
.63
SECT C-C
FULL SIZE

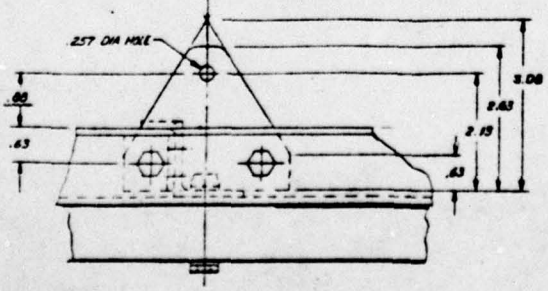


X	Y
2.550	1.230
2.400	1.384
2.250	1.537
2.100	1.689
1.950	1.841
1.800	1.991
1.650	2.141
.750	1.927
.625	1.815
.500	1.709
.375	2.039
.250	2.191
.125	2.397
.0625	2.542
0°	2.597

SECT D-D
FULL SIZE







SECT C-C
FULL SIZE

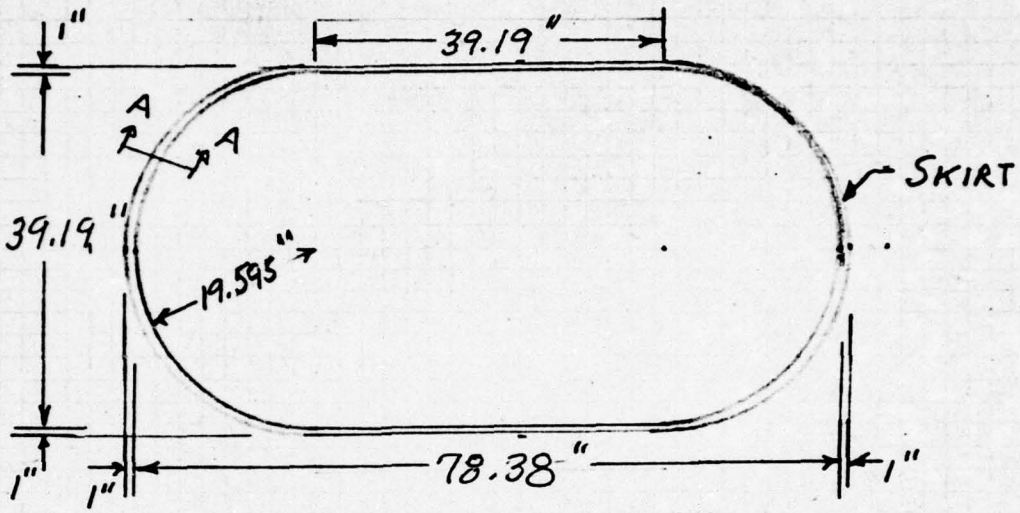
FIGURE 5

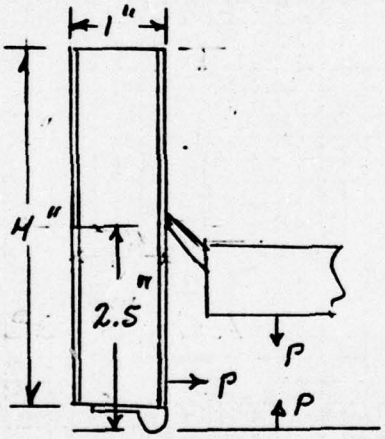
	25727	77-523

APPENDIX A

STRESS REPORT

AIR BEARING / SUCTION HOLD DOWN DEVICE

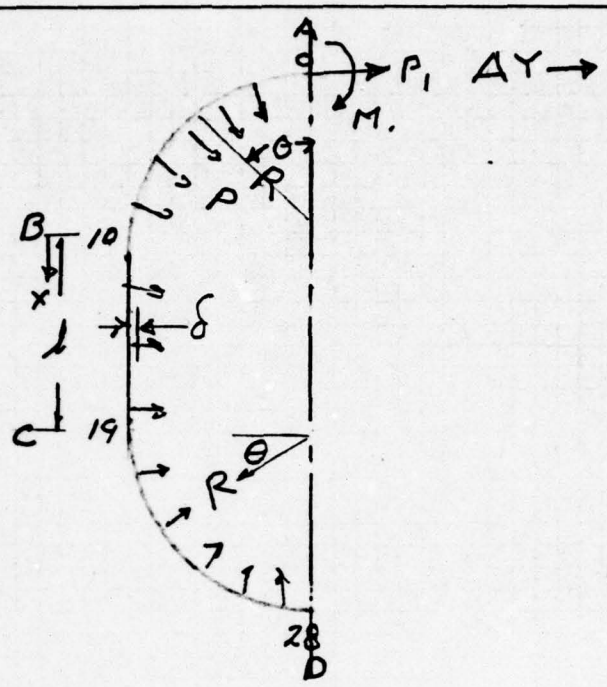




P (PRESSURE) = 3 PSI (LIMIT)

Prepared by: C. EKREM Approved by: _____ Checked by: _____

F010



SPAN A TO B

$$M = M_1 + P_1 R(1-\cos\theta) + \rho R^2(1-\cos\theta)$$

SPAN B TO C

$$M = M_1 + P_1 R + P_1 x + \rho R^2 + \rho \frac{x^2}{2}$$

SPAN C TO D

$$M = M_1 + P_1(R+l) + \rho R^2 + \rho \frac{l^2}{2} - \rho R^2(1-\cos\theta) + \rho R^2 \sin\theta + \rho R^2(1-\cos\theta)$$

$$\Delta\theta_{(A \text{ TO } D)} = \int_A^D \frac{M m_\theta ds}{EI} = 0$$

EI IS CONSTANT

$$\Delta Y_{(A \text{ TO } D)} = \int_A^D \frac{M m_Y ds}{EI} = 0$$

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SOLVING EQUATIONS (FROM TABLE)

$\Delta\theta = 100.75M_1 + 3948.397P_1 + 378290 = 0$

$\Delta Y = 3948.397M_1 + 225327P_1 + 23124316 = 0$

$P_1 = -117.569$

$M_1 = 852.808$

NET MOMENT $= M_1 + M_{P_1} + \Sigma M_P$

AXIAL LOAD $= (\Sigma H + P_1)\cos\theta - \Sigma V \sin\theta$

SHEAR $= (\Sigma H + P_1)\sin\theta + \Sigma V \cos\theta$

.5000	.5000	50.908	29.393	575.946
.3420	.6580	55.240	38.681	757.945
.1736	.8264	57.891	48.580	951.924
0	1.000	58.785	58.785	1151.892
ΔH	ΣV	ΣH	ΔM_1	ΔM_2
	58.785	58.785		
11.7	1			

BLE I
ENERGY SOLUTION OF $\int \frac{M m ds}{EI}$

	ds	M_1	$P_1 R(1-\cos\theta)$	M_p	$M_1 ds$	$P_1 ds$	$M_p ds$	$P_1^2 ds$	$M_p P_1 ds$
To B									
	1.71	1	0°	0	0	0	0	0	
	3.42		.298	17.5		1.019	60	.304	18
	3.42		1.182	69.5		4.042	238	4.778	281
	3.42		2.626	154.4		8.981	528	23.584	1387
	3.42		4.585	269.5		15.681	922	71.896	4226
	3.42		6.999	411.5		23.937	1407	167.532	9850
	3.42		9.798	575.9		33.509	1970	328.323	19298
	3.42		12.894	757.9		44.097	2592	568.593	33370
	3.42		16.193	951.9		55.380	3255	896.769	52716
	1.71	1	19.595	1151.9		33.507	1970	656.578	38598
					30.78	220.153	12942	2718.357	159744
C					d/s				
					AS				
	1.95	1	19.595	1151.9		38.210	2246	748.730	44014
	3.9		23.495	1403.9	SAME	91.631	5475	2152.86	128640
	3.9		27.395	1701.7		106.841	6637	2926.90	181810
	3.9		31.295	2045.0		122.050	7976	3819.57	249593
	3.9		35.195	2433.9		137.261	9492	4830.88	334078
	3.9		39.095	2868.6		152.471	11188	5960.83	437377
	3.9		42.995	3348.8		167.681	13060	7209.42	561528
	3.9	1	46.895	3874.7		182.891	15111	8576.65	708646

TABLE I (CO
ENERGY SOLUTI

STA	ℓ	Δℓ	ΔH	ΣV	ΣH	ΔM_1	ΔM_2	ΣM_p			cl
16	27.3			58.785	140.685						
		3.9	11.7	↑							
17	31.2				152.385	22.815	548.672	4446.148			3.9
		3.9	11.7								
18	35.1				164.085	22.815	594.302	5063.245			3.99
		4.09	12.27	↓							
19	39.19			58.785	176.355	25.092	671.108	5759.465			2.0
								SPAN C TO D			
					V	H	ΔM_p	ΣV	ΣH	$*\Sigma M_p$	
	Θ	SINΘ	COSΘ	1-COSΘ	PR(1-cosΘ)	PRSINΘ	$PR^2(1-\cos\Theta)$				
19	0	1.0	1	0	0	0	0	58.785	176.355	5759.465	1.7
20	10	.1736	.9848	.0152	-.894	10.205	17.509	57.891	186.560	6358.97	3.4
21	20	.3420	.9397	.0603	-3.545	20.104	69.459	55.240	196.459	6941.92	3.4
22	30	.5000	.8660	.1340	-7.877	29.393	154.354	50.908	205.748	7487.82	3.4
23	40	.6428	.7660	.2340	-13.756	37.787	269.543	45.029	214.142	7980.01	3.4
24	50	.7660	.6428	.3572	-20.998	45.029	411.456	37.787	221.384	8406.92	3.4
25	60	.8660	.5000	.5000	-29.393	50.908	575.946	29.392	227.263	8752.41	3.4
26	70	.9397	.3420	.6580	-38.681	55.240	757.945	20.104	231.595	9006.41	3.4
27	80	.9848	.1736	.8264	-48.580	57.891	951.924	10.205	234.246	9162.39	3.4
28	90	1.0000	0	1.000	58.785	58.785	1151.892	0	235.140	9214.36	1.7

$*\Sigma M_p = 5759.465 + \Delta M_p - 58.785\,R\,(1-\cos\Theta) + 58.785\,R\sin\Theta$

TABLE I (CONT)
GY SOLUTION OF $\int \frac{M m ds}{EI}$

	ds	M_1	$P_1R(1-\cos\theta)$	M_p	$M_1 ds$	$P_1 ds$	$M_p ds$	$P_1^2 ds$	$M_p P_1 ds$
	3.9	1	50.795	4446.1		198.100	17340	10062.5	880775
	3.995	1	54.695	5063.3		218.507	20228	11951.2	1106364
	2.045	1	58.785	5759.5		120.215	11778	7066.86	692380
					39.19	1535.858	120531	65306.4	5325205
ΣM_p									
759.465	1.71	1	58.785	5759.5		100.522	9849	5909.21	578958
358.97	3.42		62.187	6359.0		212.680	21748	13225.90	1352429
941.92	3.42		65.486	6941.9		223.962	23741	14666.4	1554723
487.82	3.42		68.583	7487.8		234.554	25608	16086.4	1756292
980.01	3.42		71.381	7980.0		244.123	27292	17425.7	1948102
406.92	3.42		73.795	8406.9		252.379	28752	18624.3	2121724
752.41	3.42		75.754	8752.4		259.079	29933	19626.2	2267560
006.41	3.42		77.198	9006.4		264.017	30802	20381.6	2377844
162.39	3.42		78.082	9162.4		267.040	31335	20851.1	2446731
214.36	1.71	1	78.380	9214.4		134.030	15757	10505.3	1235004
					30.78	2192.386	244817	157302.1	17639367
$\Sigma R \sin\theta$									
			TOTAL		100.75	3948.397	378290	225327	23124316

SAME AS ds

2

NET INTERNAL L

	ΣV	ΣH	ΣM_p	P_1	M_{P_1}	M_1	NET M_p	SINθ	COSθ	ΣH+PJ COSθ
0	0	0	0	-117.6	0	853	853	0	1	-117.6
1	10.205	.894	17.509	-	-35		834	.1736	.9848	-114.9
2	20.104	3.545	69.459		-139		783	.3420	.9397	-107.2
3	29.393	7.877	154.354		-309		698	.5000	.8660	-95.0
4	37.787	13.756	269.543		-539		584	.6428	.7660	-79.5
5	45.029	20.998	411.456		-823		441	.7660	.6428	-62.1
6	50.903	29.393	575.946		-1152		277	.866	.5000	-44.1
7	55.240	38.681	757.945		-1516		95	.9397	.342	-27.0
8	57.891	48.580	951.924		-1904		-99	.9848	.1736	-12.0
9	58.785	58.785	1151.892		-2304		-299	1.000	0	0
10		70.485	1403.969		-2763		-506	↑	↑	0
11		82.185	1701.676		-3222		-667			0
12		93.885	2045.013		-3680		-782			0
13		105.585	2438.980		-4139		-847			0
14		117.285	2868.577		-4598		-876			0
15		128.985	3348.80		-5056		-855			0
16		140.685	3874.66		-5515		-787			0
17		152.385	4446.15		-5973		-674			0
18		164.085	5063.27		-6432		-516	↓	↓	0
19	58.785	176.355	5759.47		-6913		-301	1.000	0	0
20	57.891	186.56	6358.97		-7313		-101	.9848	-.1736	-12.0
21	55.240	196.459	6941.92		-7701		94	.9397	-.3420	-27.0
22	50.908	205.748	7487.83		-8065		276	.8660	-.5000	-44.1
23	45.029	214.142	7980.01		-8394		439	.7660	-.6428	-62.1
24	37.787	221.384	8406.92		-8678		582	.6428	-.7660	-79.5
25	29.392	227.263	8752.41		-8909		696	.5000	-.8660	-95.0
26	20.104	231.595	9006.41		-9078		781	.3420	-.9397	-107.2
27	10.205	234.246	9162.39		-9182		833	.1736	-.9848	-114.9
28	0	235.140	9214.36	-117.6	-9215	853	852	0	-1.000	-117.6

TERNAL LOADS

TABLE II

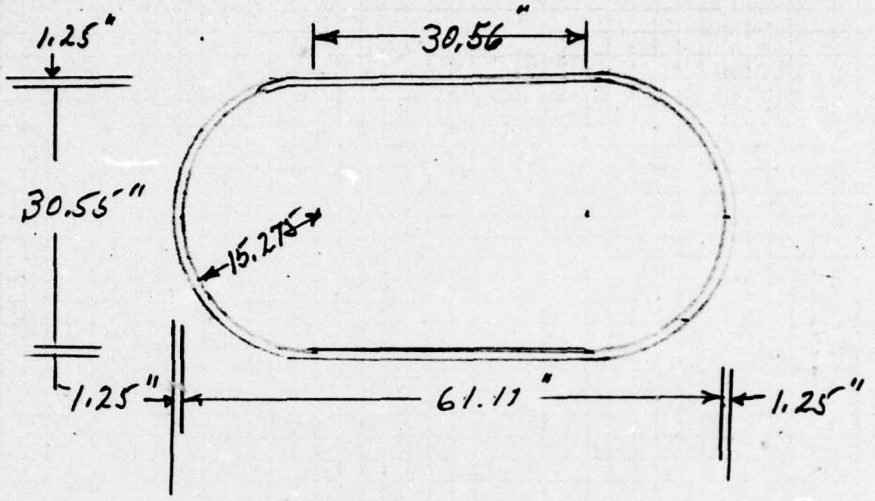
COSθ	(ΣH+P_i) COSθ	ΣV SINθ	AXIAL LOAD	(ΣH+P_i) SINθ	ΣV COSθ	SHEAR
1	-117.6	0	-117.6	0	0	0
.9848	-114.9	1.8	-113.1	-20.3	10.0	-10.3
.9397	-107.2	6.9	-100.3	-39.0	18.9	-20.1
.8660	-95.0	14.7	-80.3	-54.9	25.5	-29.4
.7660	-79.5	24.3	-55.2	-66.8	28.9	-37.9
.6428	-62.1	34.5	-27.6	-74.0	28.9	-45.1
.5000	-44.1	44.1	0	-76.4	25.5	-50.9
.342	-27.0	51.9	24.9	-74.2	18.9	-55.3
.1736	-12.0	57.0	45.0	-68.0	10.0	-58.0
0	0	58.8	58.8	-58.8	0	-58.8
↑	0	↑	↑	↑	↑	↑
	0					
	0					
	0					
	0					
	0					
	0					
	0					
↓	0	↓	↓	↓	↓	↓
0	0	58.8	58.8	58.8	0	58.8
-.1736	-12.0	57.0	45.0	68.0	-10.0	58.0
-.3420	-27.0	51.9	24.9	74.2	-18.9	55.3
-.5000	-44.1	44.1	0	76.4	-25.5	50.9
-.6428	-62.1	34.5	-27.6	74.0	-28.9	45.1
-.7660	-79.5	24.3	-55.2	66.8	-28.9	37.9
-.8660	-95.0	14.7	-80.3	54.9	-25.5	29.4
-.9397	-107.2	6.9	-100.3	39.0	-18.9	20.1
-.9848	-114.9	1.8	-113.1	20.3	-10.0	10.3
-1.000	-117.6	0	-117.6	0	0	0

TABLE III
DEFLECTION

STA	M	m	ds	EI δ
14	-876	-19.55	1.95	33395
13	-847	-17.60	3.90	58138
12	-782	-15.65	3.90	47729
11	-667	-13.70	3.90	35638
10	-506	-11.75	3.90	23127
9	-299	-9.80	3.66	10725
8	-99	-8.10	3.42	2742
7	95	-6.45	3.42	-2096
6	277	-4.90	3.42	-4642
5	441	-3.50	3.42	-5279
4	584	-2.29	3.42	-4574
3	698	-1.31	3.42	-3127
2	783	-.59	3.42	-1580
1	834	-.15	3.42	-429
0	853	- 0	1.71	0
			EIδ =	189827

DEFLECTION AT MIDPOINT OF LENGTH 39.19 IN. THIS IS THE MAXIMUM DEFLECTION OF THE SKIRT

SKIRT



THE INTERNAL LOADS IN THE SKIRT SHOWN IN TABLE II (PAGE 6) AND DEFLECTION (δ) SHOWN IN TABLE III (PAGE 7) ARE BASED ON THE DIMENSIONS SHOWN ON PAGE 1. THE SIZE OF THE SKIRT WAS CHANGED TO THE DIMENSIONS SHOWN ABOVE. THIS RESULTS IN A REDUCTION IN INTERNALS LOADS AND DEFLECTION. TO $\frac{15.275}{19.595} = .7795$ OF THE VALUES SHOWN

THE VALUES IN TABLE II AND III ARE BASED ON A SKIRT WHICH IS LOADED FOR ONE (1) INCH OF HEIGHT. HOWEVER THE LOADED HEIGHT IS 2.5 INCHES.

THE DESIGN INTERNAL LOADS IN TABLE II ARE MULTIPLIED BY $.7795 \times 2.5 \times 1.5 = 2.92$

THE DEFLECTION SHOWN IN TABLE III IS MULTIPLIED BY $.7795 \times 2.5 = 1.95$

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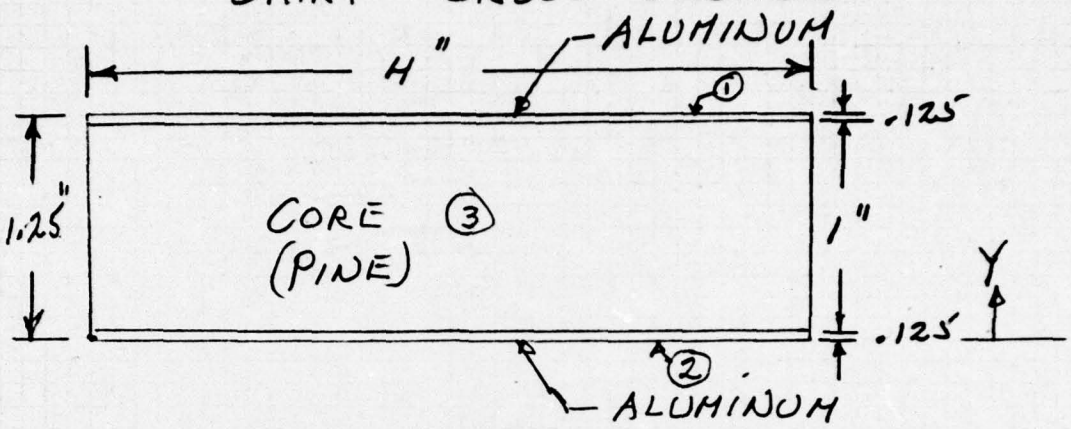
SKIRT CROSS-SECTION



PART	SIZE	K	AREA	Y	AY	AY^2	I_o
①	4X.125	1.0	.500	1.188	.594	.7057	.0007
②	4X.125	1.0	.500	.063	.0315	.0020	.0007
③	4X1.00	.126	.504	.625	.3150	.1969	.0420
			1.504		.9405	.9046	.0434

E OF PINE = 1.3×10^6 IN^2

E OF ALUM = 10.3×10^6 IN^2

$K = \frac{1.3 \times 10^6}{10.3 \times 10^6} = .126$

$\bar{Y} = \frac{.9405}{1.504} = .625$"

$I = .9046 + .0434 - 1.504(.625)^2 = .3605$ IN^4

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AT $\theta = 0$ $M = 853 \times 2.92 = 2491$ IN LBS

AXIAL LOAD $= -117.6 \times 2.92 = 343$ LBS

$$f_b = \frac{2491(-.625)}{.3605} - \frac{343}{1.504}$$

$$= -4319 - 228 = -4547 \ \#/IN^2 \ (COMP)$$

AT $\ell = 19.5$ $M = -876 \times 2.92 = 2558$ IN LBS

AXIAL LOAD $= 58.8 \times 2.92 = 172$ LBS

$$f_b = \frac{2558(-.625)}{.3605} + \frac{172}{1.504}$$

$$= 4435 + 114 = 4549 \ \#/IN^2 \ (TENS)$$

DEFLECTION

$$\delta = \frac{189827 \times 1.95}{10.3 \times 10^6 \times .3605} = .0997 \text{ IN.}$$

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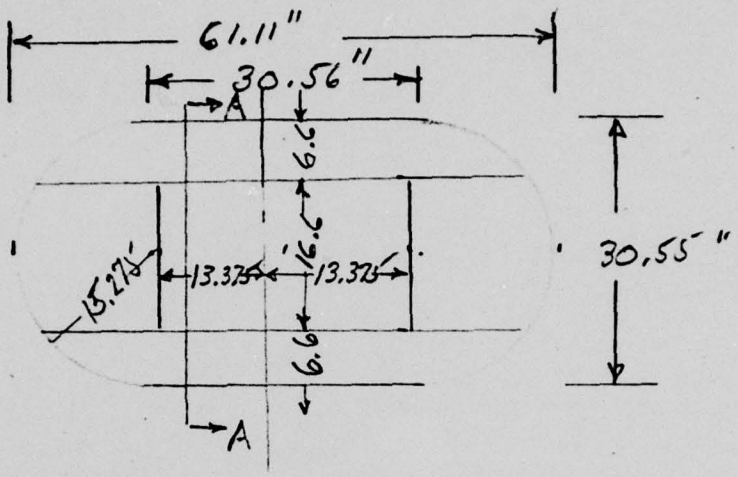
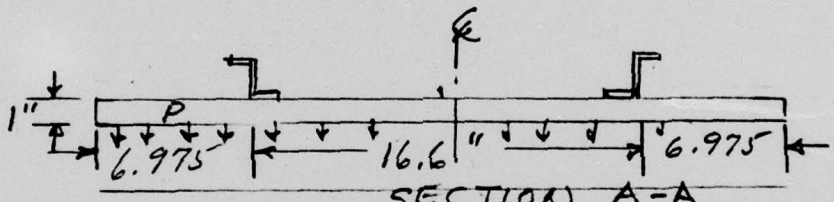
PLAT FORM





SECTION A-A

$P = 3\ psi\ (LIMIT) = 4.5\ psi\ (ULT)$

BENDING MOMENT @ "Z" $= 4.5 \times \frac{\overline{6.975}^2}{2} = 109$ IN LBS PER INCH WIDTH OF PLATFORM

BENDING MOMENT @ $\mathcal{L}$

$$4.5 \times \frac{(6.975+8.3)^2}{2} - 4.5(6.975+8.3) \times 8.3$$

$= 525 - 571 = -46$ IN LBS PER INCH WIDTH OF PLATFORM

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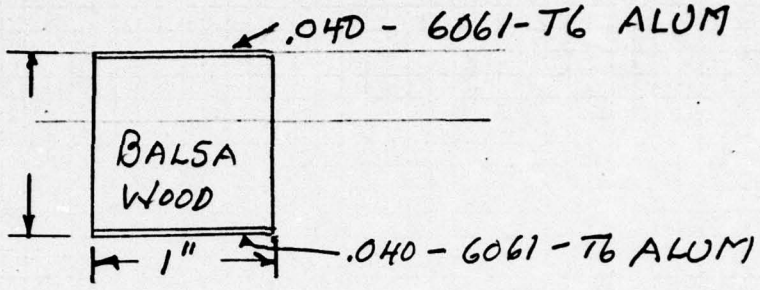
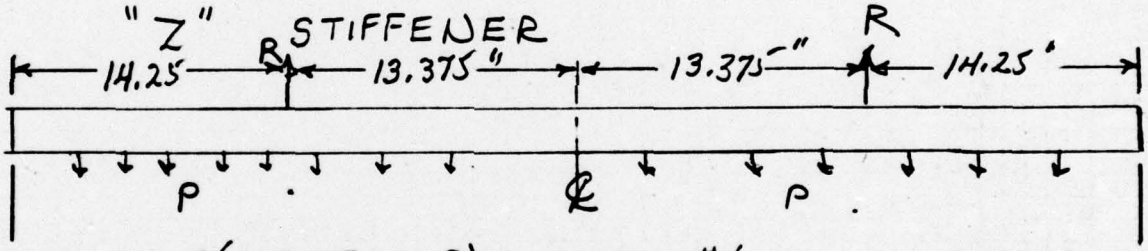
PLATFORM CROSS-SECTION



$I = [.040 \times 1 \times (.5-.02)^2] \times 2 = .0184\ IN^4$ (NEGLECTS BALSA)

$f_b = \frac{109 \times .5}{.0184} = 2962\ \#/IN^2$



$P = 4.5(6.975 + 8.3) = 68.74\ \#/IN$

$R = 68.74(14.25+13.375) = 1899\ \#$

BENDING MOMENT AT "R" $= 68.74 \times \frac{14.25^2}{2} = 6979$ IN LBS

" " " ℄ $= 68.74\left(\frac{14.25+13.375}{2}\right)^2 - 1899 \times 13.375$

$= 26229 - 25399 = 830$ IN LBS

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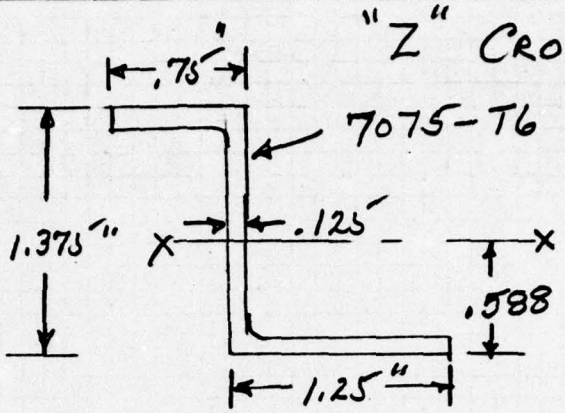
"Z" CROSS-SECTION



$$f_b = \frac{6979\ (1.375 - .588)}{.1085} = 50622\ \#/IN^2\ (TENS)$$

$$f_b = \frac{6979 \times .588}{.1085} = 37822\ \#/IN^2\ (COMP.)$$

ALLOWABLE TENSION = 78000 #/IN² MIL-HDBK-5A

ALLOWABLE COMPRESSION = .9 F_{CY} = .9 × 71000 = 63900 #/IN²
(BRUHN FIG C7.9)

M.S. = (78000/50622) − 1 = .54

THE PLATFORM PANEL IS ATTACHED TO THE "Z" BY MS24694 BOLTS AT 3" SPACING

LOAD PER FASTENER = 3 × 68.74 = 206 LBS

ALLOW PER BOLT = 4550 # TENS

M.S. = $\frac{4550}{206} - 1$ = LARGE

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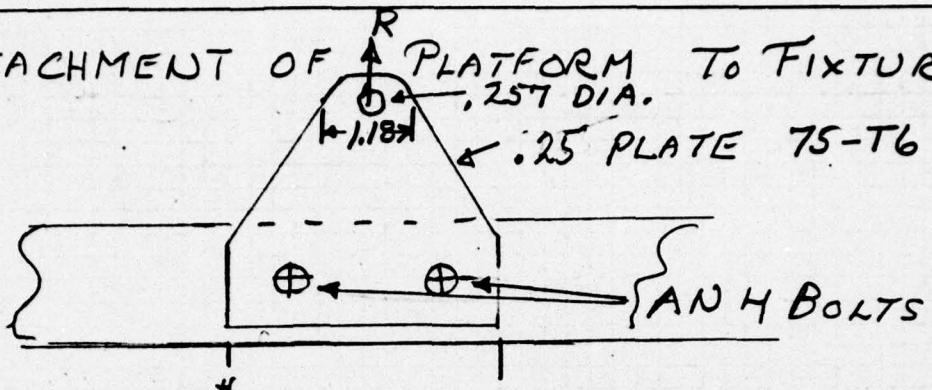
ATTACHMENT OF PLATFORM TO FIXTURE



$R = 1899^{\#}$

ALLOWABLE SHEAR PER BOLT = 3682 LBS

$$M.S. = \frac{2 \times 3682}{1899} = +3.88$$

TENSION IN .25 PLATE

$$= \frac{1899}{(1.18-.257).25} = 8230\ ^{\#}/IN^2$$

ALLOWABLE $= 76000\ ^{\#}/IN^2$

$$M.S = \frac{76000}{8230} - 1 = +8.23$$

Prepared by: _____ Approved by: _____ Checked by: _____

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